SCIENCE

FRIDAY, SEPTEMBER 11, 1914

CONTENTS

Address to the Botanical Section of the British Association for the Advancement of Science: DR. F. O. BOWER. 357

The Decreasing Birth Rate of the German Empire: DR. A. ALLEMANN 372

Patent Medicines in Great Britain 374

The Twenty-fifth Anniversary of the Missouri Botanical Garden 375

Scientific Notes and News 376

University and Educational News 378

Discussion and Correspondence:—

Do Azotobacter Nitrify? DR. WM. P. HEADDEN. *Northern Lights in Summer:* ALBERT B. REAGAN 379

Scientific Books:—

The Cambridge Manuals of Science and Literature: PROFESSOR T. D. A. COCKERELL. *The American College:* DR. F. P. KEPPEL 381

Scientific Journals and Articles 383

Special Articles:—

The Measurement of Changes in the Rate of Fecundity of the Individual Fowl: DR. RAYMOND PEARL 383

The North Carolina Academy of Science: DR. E. W. GUDGER 384

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ADDRESS TO THE BOTANICAL SECTION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

To preside over the Botanical Section on the occasion of its first meeting in Australia is no slight honor, though it also imposes no small responsibility. We members from Great Britain have a deep sense of the advantage which we derive from visiting these distant shores. I am doubtful whether any scientific profit we can confer by our coming here can balance that which we receive; while over and above this is the personal kindliness of the Australian welcome, which on behalf of the visitors of this section from the old country I take this opportunity of gratefully acknowledging. Of the members of the British Association, those who pursue the national sciences may expect to gain most by their experiences here; and perhaps it is the botanists who stand to come off best of all. Living as most of us do in a country of old cultivation, the vegetation of which has been controlled, transformed, and from the natural floristic point of view almost ruined by the hand of man, it is with delight and expectation that we visit a land not yet spoiled. To those who study ecology, that branch of the science which regards vegetation collectively as the natural resultant of its external circumstances, the antithesis will come home with special strength, and the opportunity now before them of seeing nature in her pristine state will not, I am sure, be thrown away.

I may be allowed here to express to the Australian members of the Section my regret that the presidency for this occasion

[1] Australia, 1914.

should not have fallen to one who could with unusual weight and knowledge have addressed them from the floristic and geographical point of view. I mean, to Professor Bayley Balfour, of Edinburgh, who was actually invited by the council to preside. He could have handled the subject of your rich and peculiar flora with detailed knowledge; and, with the true Hookerian touch, he would have pictured to you in bold outlines its relation to present problems. Failing such equipment, I may at least claim to have made some of your rare and peculiar forms the subject of special study at intervals spread over thirty years: for it was in 1884 that I was supplied with living plants of *Phylloglossum* by Baron Ferdinand von Müller, while a paper to be published this year contains details of a number of ferns kindly sent to me by various collectors from New Zealand. I have been personally interested more especially in your rare Pteridophytes, isolated survivals as they surely are of very ancient vegetation. I propose to indicate later in this address some points of interest which they present. But first I shall offer some more general remarks on the history of the investigation of the Australian flora, as a reminder of the recent death of Sir Joseph Hooker, whose work helped so greatly to promote a philosophical knowledge of the flora of this quarter of the globe.

Few, if any, of the large areas of the earth's surface have developed their coat of vegetation under such interesting conditions as that which bears the Australasian flora. In its comparative isolation, and in its freedom from the disturbing influence of man, it may be held as unique. We may picture to ourselves the field as having been open to evolutionary tendencies, unusually free from the incursion of competitive foreign types, and with its flora shaped and determined through long ages in the main by climatic influences. Naturally the controlling effect of animal life had been present throughout, as well as that of parasitic and fungal attack; but that potent artificial influence, the hand of man, was less effective here than in almost any other area. The aborigines were not tillers of the soil: in their digging for roots and such-like actions they might rank with the herbivorous animals, so far as they affected the vegetation. Probably the most powerful influence they exercised was through fire. And so the conditions remained, the native flora being practically untouched, till the visit of Captain Cook in 1770: for little account need be taken of the handful of specimens collected by Dampier in the seventeenth century.

Captain Cook shipped with him in the *Endeavour* a very remarkable man, viz., Joseph Banks, whom Dr. Maiden has described as "the Father of Australia." He not only acted as the scientific director of the expedition, but he was also its financier. Educated at Eton and Oxford, he found himself as a young man possessed of an ample fortune. Though devoted to field sports, he did not, like so many others, spend his life upon them. Following the dictates of a taste early awakened in him, he turned his attention to travel for scientific ends. His opportunity came when Cook was fitting out the *Endeavour* for his first voyage to the southern seas. Banks asked leave of the Admiralty to join the expedition, which was granted, and he furnished all the scientific stores and a staff of nine persons at his own expense.

The story of that great expedition of 1768 to 1771 is given in "Cook's Voyages," compiled by Dr. Hawkesworth, a book that may be found in every library. Though it is evident throughout that Banks took a leading part in the observational

work of the expedition, it has not been generally known how deeply indebted Hawkesworth was to Banks for the scientific content of his story. This became apparent only on the publication of Banks's own journal 125 years after the completion of the voyage. The circumstances of this have a local interest, so I may be excused for briefly relating them.

Banks's papers, including the MS. journal, passed with his library and herbarium on his death to his librarian, Robert Brown. On the death of the latter they remained in the British Museum. But after lying there for a long period they were claimed and removed by a member of Banks's family, and were put up for auction. The journal was sold for £7 2s. 6d., and the last that has been heard of it is that it came into the possession of a gentleman in Sydney. Perhaps it may be lying within a short distance of the spot where we are now met. This valuable record, fit to rank with Darwin's "Voyage of the *Beagle*," or Moseley's account of the "Voyage of the *Challenger*," might thus have been wholly lost to the public had it not been for the care of Dawson-Turner, who had the original transcribed by his daughters, helped by his grandson, Joseph Dalton Hooker. The boy was fascinated by it, and doubtless it helped to stimulate to like enterprises that botanist to whom Australia owes so much. The copy thus made remained in the British Museum. Finally, from it in 1896 Sir Joseph Hooker himself edited the journal, in a slightly abridged form. It is now apparent how very large a share Banks actually took in the observation and recording, and how deeply indebted to him was the compiler of the account of the voyage published more than a century earlier, not only for facts, but even for lengthy excerpts.

The plants collected in Australia by this expedition amounted to some 1,000 species, and with Banks's herbarium they found, after his death, a home in the British Museum. Several minor collections were subsequently made in Australia, but the next expedition of prime importance was that of Flinders in 1801 to 1805. What made it botanically notable was the presence of Robert Brown. Hooker speaks of this voyage as being, "as far as botany is concerned, the most important in its results ever taken." The collections came from areas so widely apart as King George's Sound, southern Tasmania, and the Gulf of Carpentaria. These, together with Banks's plants and other minor collections, formed the foundation for Brown's "Prodromus Floræ Novæ Hollandæ," a work which was described in 1860 by Sir Joseph Hooker as being "though a fragment . . . the greatest botanical work that has ever appeared." It was published in 1810. I must pass over without detailed remark the notable pioneer work of Allan Cunningham, and of some others. The next outstanding fact in the history of Australian botany was the voyage of Ross, with the *Erebus* and the *Terror*: for with him was Joseph Hooker, whose botanical work gave an added distinction to an otherwise remarkable expedition.

The prime object of the voyage was a magnetic survey, and this determined its course. But in the intervals of sailing the Antarctic seas the two ships visited Ascension Island, St. Helena, the Cape, New Zealand, Australia, Tasmania, Kerguelen Island, Tierra del Fuego, and the Falkland Islands. Thus Hooker had the opportunity of collecting and observing upon all the great circumpolar areas of the southern hemisphere. He welded together the results into his great work "The Antarctic Flora." It was published in six large quarto volumes. In them about 3,000

species are described, while on 530 plates 1,095 species are depicted, usually with detailed analytical drawings. But these magnificent volumes did not merely contain reports of explorations, or descriptions of the many new species collected. There was much more than this in them. All the known facts that could be gathered were incorporated, so that they became systematically elaborated and complete floras of the several countries. Moreover, in the last of them, the "Flora Tasmaniæ," there is an introductory essay, in which the Australasian flora was for the first time treated as a whole, and its probable origin and its relation to other floras discussed. Further, questions of the mutability and origin of species were also raised in it. The air was full of such questions in 1859; the essay was completed in November of that year, less than twelve months after the joint communications of Darwin and Wallace had been made to the Linnean Society, and before the "Origin of Species" was published. It was to this essay that Darwin referred when he wrote that "Hooker has come round, and will publish his belief soon." But this publication of his belief in the mutability of species was not merely an echo of assent to Darwin's own opinion. It was a reasoned statement, advanced upon the basis of his "own self-thought," and his own wide systematic and geographical experience. From these sources he drew support for "the hypothesis that species are derivative and mutable." He points out how the natural history of Australia seemed especially suited to test such a theory, on account of the comparative uniformity of the physical features being accompanied by a great variety in its flora, and the peculiarity of both its fauna and flora, as compared with other countries. After the test had been made on the basis of the study of some 8,000 species of plants, their characters, their spread, and their relations to those of other lands, Hooker concluded decisively in favor of mutability, and a doctrine of progression. After reading this essay, Darwin wrote that it was to his judgment "by far the grandest and most interesting essay on subjects of the nature discussed I have ever read."

But beyond its historical interest in relation to the "Origin of Species," Hooker's essay contained what was up to its time the most scientific treatment of a large area from the point of view of the plant-geographer. He found that the Antarctic, like the Arctic flora, is very uniform round the globe. The same species in many cases occur on every island, though thousands of miles of ocean may intervene. Many of these species reappear in the mountains of southern Chili, Australia, Tasmania, and New Zealand. The southern temperate floras, on the other hand, of South America, South Africa, Australia, and New Zealand differ more among themselves than do the floras of Europe, northern Asia, and North America. To explain these facts Hooker suggested the probable former existence, during a warmer period than the present, of a center of creation of new species in the Southern Ocean, in the form of either a continent or an archipelago, from which the Antarctic flora radiated. From the zoological side a similar difficulty arises, and the hypothesis of a land-connection has been widely upheld, and that it existed as late as Mid-Tertiary times. The theory took a more definite form in the hands of Osborn (1900), who pictured relatively narrow strips of land connecting respectively South America on the one side and Tasmania and New Zealand on the other with the existing Antarctic land-area. This would accord well enough with the suggestion of Lothian Green, that the

plan of land-elevations on the earth is approximately tetrahedral; and it is, I believe, in line with the views of those who are best informed on antarctic geography and geology, as studied from the land itself. It may be hoped that further antarctic discovery may bring fresh facts to bear upon this question, for it is to the positive data acquired from study of the earth's crust that we must look, rather than to the exigencies of botanists and zoologists, for its final solution.

But the hypothesis of an Antarctic land-connection has been held open to doubt in various quarters. As Sir Wm. Thiselton Dyer has recently pointed out, Darwin himself dissented, though regretfully, from the sinking of imaginary continents in a quite reckless manner, and from the construction of land-bridges in every convenient direction. From the geological side Dana laid down the positive proposition that the continents and oceans had their general outline and form defined in earliest time. Sir John Murray, whose recent death we so deeply deplore, was an undeniable authority as to the ocean-floor. He wrote quite recently with regard to Gondwana-land, that "the study of ocean-depths and ocean-deposits does not seem in any way to support the view that continental land has disappeared beneath the floor of the ocean in the manner indicated." He suggested that the present distribution of organisms is better interpreted by the North Polar theory of origin. The "continuous current of vegetation" southward at the present time was recognized by Hooker himself, and definite streams of northern forms have been traced by him extending even to Australia and Tasmania. This might account for much in present-day distribution; though it seems doubtful whether it would fully explain the extraordinary distribution of Antarctic plants. The problem must for the present remain an open one.

This whole question, however, has a connection with the still wider difficulty of the existence within the polar area of ancient floras. In the north the fossils are even of sub-tropical character. Coal has been found in lands with a five months' night. How did such plants fare if the seasonal conditions were at all like the present? To explain this it would be a physiological necessity to assume either an entirely different climatal condition in those regions from that of the present time; or, as has been suggested, some shifting or creeping of the earth's crust itself. These are, however, questions which we can not undertake to discuss with effect in the Botanical Section. We must not do more than recognize that an unsolved difficulty exists.

We pass now from Hooker's great work to the last of the classical series, viz., the "Flora Australiensis" of Bentham and Baron Ferdinand von Müller. It is embodied in seven volumes, and was completed in 1878. Bentham, while assenting in his "concluding preface" to the principles laid down by Hooker in the Tasmanian flora, recognized as the chief component part of the present flora of Australia the indigenous genera and species, originated or differentiated in Australia, which never spread far out of it. Secondly, an Indo-Australian flora showing an ancient connection between Australia and the lands lying to the north. It is represented especially in tropical and sub-tropical east Queensland. Then there is the mountain flora common to New Zealand, and extending generally to the southern extra-tropical and mountain regions, while other constituents are ubiquitous maritime plants, and those which have been introduced since the European colonization. But the most remarkable, as they are

the least easily explained, are some few plants identical with species from North and West America, and from the Mediterranean. They are stated to be chiefly annuals, or herbaceous or shrubby plants; free-seeders; while their seeds long retain the power of germination. This may perhaps give the clue to this curious conundrum of distribution.

It has been fortunate that the duty of working out this remarkable flora should have fallen into the hands of such masters as Robert Brown, Sir Joseph Hooker, and Bentham. The foundations were thus surely laid. The further progress of knowledge has been carried on by the late Baron Ferdinand von Müller, and it may be confidently left in the hands of others who are still with us. The completion of the task of observing and recording may still be far ahead. But I may be pardoned if I utter a word of anticipatory warning. There is at the present time a risk that the mere work of tabulating and defining the species in a given country may be regarded as the only duty of a government botanist; that, whenever this is completed, his occupation will be gone. Some such erroneous idea, together with a short-sighted economy, is the probable explanation of the fact that certain positions hitherto held by professional botanists have recently been converted into positions to be held by agriculturists. In the countries where this has happened (and I refer to no part of Australasia) the vegetation had been very adequately, though not yet exhaustively, worked, as regards the flowering plants and ferns. But who that knows anything about plants would imagine that the ascription to a genus or order, or the designation by a couple of Latin names with a brief specific description, exhausts what it is important to know about a species? In most cases it is after this has been done that the real importance of its study begins. Such possibilities as these do not appear to have been appreciated by those who advised or controlled these official changes. I have no desire to undervalue the agriculturist or the important work which he does. But he is engaged in the special application of various pure sciences, rather than in pure science itself. Advance in the prosperity of any country which has progressed beyond the initial stages of settlement follows on the advance of such knowledge as the devotee of pure science not only creates, but is also able to inculcate in his pupils. It is then imperative that, in any state which actively progresses, provision shall be made for the pursuit of pure as well as of applied science. In my view an essential mistake has been made in changing the character of the appointments in question from that of botanists to that of agriculturists. For the change marks the abandonment of pure science in favor of its specialized and local application.

The head of such an institution should always be a representative of pure science, thoroughly versed in the nascent developments of his subject. He could then delegate to specialists the work of following out into detail such various lines of special application as agriculture, acclimatization, plant-breeding, forestry or economics. Or, if the organization were a large one, as we may anticipate that it would become in the capital of a great state, separate institutes might develop to serve the several applied branches, while to a central institute, in touch with them all, might be reserved the duty of advancing the pure science from which all should draw assistance and inspiration.

It matters little how this principle works out in detail, if only the principle itself be accepted, viz., that pure science is the fount

from which the practical applications spring. Sydney, as the capital of a great state, has already laid her course, as regards botanical science, in accordance with it. Her botanic garden and the recently developed botanical department in the university (which, I understand, may find its home ultimately in the botanic garden) will serve as centers of study of the pure science of botany. This will readily find its application to agriculture, to forestry, to economics, and in various other lines present and future. I am convinced that it is in the best interest of any state that can possibly afford to do so to encourage and liberally endow the central establishment where the pure science of botany is pursued, and to continue that encouragement and endowment, even though results of immediate practical use do not appear to be flowing from it at any given moment. For in these matters it is impossible to forecast what will and what will not be eventually of practical use. And in any case as educational centers the purely botanical establishments will always retain their important function of supplying that exact instruction, without which none can pursue with full effect a calling in the applied branches.

We may now turn from generalities to certain special points of interest in your peculiar flora which happen to have engaged my personal attention. They center round a few rare and isolated plants belonging to the Pteridophyta, a division of the vegetable kingdom which there is every reason to believe to have appeared early in the history of evolution. But though the type may be an ancient one it does not follow that every representative of it preserves the pristine features intact. Throughout the ages members of these early families may themselves have progressed. And so among them to-day we may expect to find some which preserve the ancient characters more fully than others. The former have stood still, and may be found to compare with curious exactitude with fossils even of very early date. The latter have advanced, and though still belonging to the ancient family, are by their modifications become essentially modern representatives of it. For instance, the fern *Angiopteris* has a sorus which very exactly matches sori from the Paleozoic period, and it may accordingly be held to be a very ancient type of fern. On the other hand, the genera *Asplenium*, or *Polypodium*, include ferns of a type which has not been recognized from early fossil-bearing rocks, and they may be held to be essentially modern. But still all of them clearly belong to the family of the ferns.

In the Australian flora only three of the four divisions of the Pteridophyta are represented. For, curiously enough, there does not appear to be any species on your continent of the widely spread genus *Equisetum*, the only living genus of that great phylum of the Equisetales, which figured so largely in the Paleozoic period; and this notwithstanding that one species (*E. debile*) is present among the Polynesian Islands. But all the three other divisions of the Pteridophyta are included, and are represented in each case by plants which show peculiar and, probably for the most part, archaic characters. I propose to sketch before you very briefly the points of interest which the more notable of these archaic types present. Some justification may be found for my doing so because nearly all of them have been submitted to detailed study in my laboratory in Glasgow, and much of the work has been done upon material supplied to me by your own botanists. I take this opportunity of offering to them collectively my hearty thanks.

The tenure by Dr. Treub of the office of

director of the botanic gardens of Buitenzorg was rendered famous by his personal investigations, and chiefly by his classical researches on the Lycopods. These were followed up by other workers, and notably by Bruchmann; so that we now possess a reasonable basis for comparison of the different types of the family as regards the prothallus and embryology, as well as of the sporophyte plant; and all of these characters must be brought together as a basis for a sound conclusion as to their phyletic seriation. The most peculiar living Lycopods are certainly *Isoëtes* and *Phylloglossum*, both of which are found in Australia. The former need not be specially discussed here, as it is a practically world-wide genus. It must suffice to say that it is probably the nearest living thing to the fossils *Lepidodendron* and *Sigillaria*, and may be described as consisting of an abbreviated and partially differentiated *Lepidostrobus* seated upon a contracted stigmarian base.

But *Phylloglossum*, which is peculiar to the Australasian region, naturally claims special attention. The plant is well known to botanists as regards its external features, its annual storage tuber, its leafy shoot with protophylls and roots, and its simple shaft bearing the short strobilus of characteristic Lycopod type. But its prothallus has never been properly delineated, though it was verbally described by Dr. A. P. W. Thomas in 1901.[2] Perhaps the completed statement may have been reserved as a pleasant surprise for this meeting. But the description of thirteen years ago clearly shows its similarity to the type of *Lycopodium cernuum*. The sporophyte compares rather with *L. inundatum*. Both of these are species which, though probably not the most primitive of the genus, are far from being the most advanced. As all botanists know, the question of the position of *Phylloglossum* chiefly turns upon the view we take of the annual tuber and its protophylls. Treub, finding similar conditions in certain embryos of Lycopods, called it a "protocorm," and believed that he recognized in it an organ of archaic nature, which had played an important part in the early establishment of the sporophyte in the soil, physiologically independent of the prothallus. I must not trouble you here with the whole argument in regard to this view. Facts which profoundly affect the conclusion are those showing the inconstancy of occurrence of the organ. Mr. Holloway has recently described it as of unusual size in your native *L. laterale*, as it is also in *L. cernuum*. But it is virtually absent in those species which have a large intraprothallial foot, such as *L. clavatum*, as well as in the genus *Selaginella* and in *Isoëtes*. In *L. Selago*, which on other grounds appears to be primitive, there is no "protocorm." Such facts appear to me to indicate caution. They suggest that the "protocorm" is an opportunist local swelling of inconstant occurrence, which, though biologically important in some cases, is not really primitive.

If this is the comparative conclusion, then our view will be that *Phylloglossum* is a type of Lycopod which has assumed, perhaps relatively recently, a very practical mode of annual growth. Related, as it appears to be on other points, with the *L. inundatum* group of species, it has bettered their mode of life. *L. inundatum* dies off each year to the very tip of its shoot, so that only the bud remains to the following season. It is notable that Goebel has described long ago how the young adventitious buds of this species start with small "protocorms," quite like those of *Phylloglossum* itself, or like the embryo of *L. cernuum*. And so we may conclude that in *Phylloglossum* a tuberous development, containing a store to start the plant in the spring,

[2] *Proc. Roy. Soc.*, Vol. 69, p. 285.

has been added to what is already seen normally each year in *L. inundatum*. And this mode of life of *Phylloglossum* begins, as Thomas has shown, with its embryo. This appears to me to be a rational explanation of the "protocorm" of *Phylloglossum;* but it robs the plant of much of its theoretical interest as an archaic form.

The phylum of the Sphenophyllales was originally based on certain slender straggling plants of the genus *Sphenophyllum* found in the Paleozoic rocks; but apparently died out in the Permian period. Your native genera *Tmesipteris* and *Psilatum* were ranked by earlier botanists with the Lycopods, but a better acquaintance with their details, and especially the examination of numerous specimens on the spot, indicated a nearer affinity for them with the Sphenophyllales. It was Professor Thomas who, in 1902, first suggested that the Psilotaceæ might be included with the Sphenophyllæ in the phylum of the Sphenophyllales, and I personally agree with him. Dr. Scott, however, dissents, on the ground that the leaves are persistently whorled in the sphenophylls, while they are alternate in the Psilotaceæ; and while the former branch monopodially the latter dichotomize. But since both of these characters are seen to be variable within the not far distant genus *Lycopodium,* the differences do not seem to me to be a sufficient ground for keeping them apart as the separate phyla of Sphenophyllales and Psilotales. Whatever degree of actual relation we trace, such plants as *Tmesipteris* and *Psilotum* are certainly the nearest living representatives of the Sphenophylleæ, a fact which gives them a special distinction. The Psilotaceæ also stand alone in the fact that they are the only family of the Pteridophytes in which the gametophyte is still unknown. They produce spores freely, but there the story stops. Any young Australian who hits upon the way to induce these recalcitrant spores to germinate, and to produce prothalli and embryos, or who found their prothalli and embryos in the open, would have before him a piece of work as sensational as anything that could be suggested. Further, I am told that *Tmesipteris* grows here on the matted stumps of *Todea barbara*. I shall be alluding shortly to the fossil Osmundaceæ. May we not venture to fancy the possibility of some fossil *Osmunda* being found which has embalmed for us among its roots a Mesozoic or even a Tertiary Sphenophyll? And thus a link might be found between the Paleozoic types and the modern Psilotaceæ, not only in time, but even in character.

We pass now to the last phylum of the Pteridophyta, the Filicales. I am bound to say that for me its interest far outweighs that of others, and for this reason: that it is represented by far the largest number of genera and species at the present day, while there is a sufficiently continuous and rich succession of fossil forms to serve as an efficient check upon our comparative conclusions.

Since 1890 it has been generally accepted that the Eusporangiate ferns (those with more bulky sporangia) were phyletically the more primitive types, and the Leptosporangiate (those with more delicate sporangia) the derivative, and in point of time later. The fossil evidence clearly upholds this conclusion. But, further, it has been shown that the character of the sporangium is merely an indicator of the general constitution of the plants in question. Where it is large and complex, as in the Eusporangiates, all the apical segmentations are, as a rule, complex, and the construction of the whole plant relatively bulky. Where the sporangium is delicate and relatively simple all the apical segmentations follow suit, and the construction of the

plant is on a less bulky model. On this basis we may range the ferns roughly as a sequence, starting from relatively bulky types of the distant past, and progressing to the more delicate types of the present day. The large majority of the living species belong naturally to the latter. But the former are still represented by a few genera and species which, like other survivals from a distant past, are frequently of very restricted distribution.

An interesting feature of the Australasian flora is that a considerable number of these relatively ancient forms are included in it. Thus the Marattiaceæ are represented by one species of *Marattia* and one of *Angiopteris*. Though in themselves interesting, they will be passed over without special remark, as they are very widely spread tropical forms.

All the three genera of Ophioglossaceæ are included, there being two species of *Ophioglossum* and two of *Botrychium*, while *Helminthostachys* is recorded from Rockingham Bay. This family is coming more than ever to the front in our comparisons, owing to their similarity in various aspects to the ancient Botryopterideæ. Though the Ophioglossaceæ have no secure or consecutive fossil history, still they may now be accepted as being very primitive but curiously specialized ferns. Perhaps the most interesting point recently detected in them is the suspensor found by Dr. Lyon in *Botrychium obliquum*, and by Dr. Lang in *Helminthostachys*. This provides a point for their comparison with the similar embryonic condition in *Danæa*, as demonstrated by Professor Campbell. The existence of a filamentous initial stage of the embryo is thus shown for three of the most primitive of living ferns. Its existence in all of the Bryophytes, and in most of the Lycopods, as well as in the seed-plants, is a very significant fact. Dr. Lang suggests that "the suspensor represents the last trace of the filamentous juvenile stage in the development of the plant, and may have persisted in the seed-plants from their filicineous ancestry." Such a possibility would fit singularly well with the theory of encapsulation of the sporophyte in the venter of the archegonium.

The representation of the ancient family of the Osmundaceæ in the Australasian flora is very fine, though limited to five living species, while *Osmunda* itself is absent. It is, however, interesting that the family dates back locally to early fossil times. It was upon two specimens of *Osmundites* from the Jurassic rocks in the Otago district of New Zealand that the series of remarkable papers on "The Fossil Osmundaceæ" by Kidston and Gwynne-Vaughan was initiated. It is no exaggeration to say that these papers have done more than any other recent researches to promote a true understanding not only of the Osmundaceæ themselves, but of fern-anatomy as a whole. They have placed the stellar theory in ferns for the first time upon a basis of comparison, checked by reference to stratigraphical sequence. It would be leading us too far for me to attempt here to summarize the important results which have sprung from the study of those fossils, so generously placed by Mr. Dunlop in the hands of those exceptionally able to turn them to account. It must suffice to say that it is now possible to trace as a fairly continuous story the steps leading from the protostelic state to the complex condition of the modern *Osmunda*. These facts and conclusions are to be put in relation with the anatomical data fast accumulating from the Ophioglossaceæ in the hands of Professor Lang and others. From such comparisons a rational explanation of the evolutionary steps leading to the complex stellar state in ferns at large begins to emerge. This is no mere tissue of

surmise, for the conclusions are based on detailed comparison of types occurring in lower horizons with those of the present day.

I must pass over with merely nominal mention your interesting representation of the ancient families of Schizæaceæ, Gleicheniaceæ and Hymenophyllaceæ, all of which touch the very foundations of any phyletic system of ferns. Also the magnificent array of Dicksonieæ and Cyatheæ, and of the important genus *Lindsaya*—ferns which take a rather higher position in point of view of descent. But I am bound to devote a few moments to one of your most remarkable ferns, endemic in New Zealand—the monotypic *Loxsoma*.

This species has peculiar characters which justify its being regarded systematically as the sole representative of a distinct tribe. It is also restricted geographically to the North Island of New Zealand. These facts at once suggest that it is an ancient survival, a conclusion with which its solenostelic axis, its sorus and sporangium, and its prothallus readily accord. I have lately shown that the Leptosporangiate ferns fall into two distinct series, those in which the origin of the sorus is constantly superficial, and those in which it is as constantly marginal. *Loxsoma* is one of the "Marginales." It shares this position with the Schizæaceæ, Thyrsopterideæ, Hymenophyllaceæ and Dicksonieæ, and the derivatives Davalieæ and Oleandreæ. Its nearest living relative is probably *Thyrsopteris,* which is again a monotypic species endemic in the island of Juan Fernandez. There is also a probable relation to the genus *Loxsomopsis,* represented by one species from Costa Rica, and a second lately discovered in Bolivia. Such a wide and isolated distribution of types, which by their characters are certainly archaic, suggests that we see in them the relics of a Filicineous state once widely spread, which probably sprang from a Schizæaceous source, and with them represent the forerunners of the whole marginal series. If we look for further enlightenment from the fossils, it is to the secondary rocks that we should turn. It is then specially interesting that Mr. Hamshaw Thomas has lately described a new Jurassic fern, *Stachypteris Halli,* which has marginal sori, and is probably referable to a position like that of *Loxsoma* and *Thyrsopteris,* between the Schizæaceæ and the Dicksonieæ. In fact the gaps in the evolutionary series of the Marginales are filling up. We may await with confidence fresh evidence from the Jurassic period, upon which Professor Seward is directing an intensive interest.

I should be ungrateful indeed if I did not mention your very full representation of Blechnoid ferns: for developmental material of several of these has been sent to me by Dr. Cockayne, and others from New Zealand. A wide comparative study of the genus has led me to somewhat unexpected results in regard to the plasticity of the sorus, its phyletic fusions and disruptions. The consequent derivative forms are seen in *Woodwardia* and *Doodya,* on the one hand, and on the other in *Scolopendrium* and *Asplenium.* These ferns together constitute a coherent phylum springing ultimately from a Cyatheoid source. The details upon which this conclusion is based I hope to describe in a separate communication to the section.

And lastly, the Hydropterideæ deserve brief mention. Represented in your flora by two species of *Azolla,* and one each of *Marsilea* and *Pilularia,* they typify a condition which must theoretically have existed among ferns in very early times, viz., the heterosporous state. But hitherto, notwithstanding the existence of our living Hydropterideæ, no fossil fern with microscopic

structure preserved had been detected from the primary rocks, showing this intermediate condition between the homosporous type and that of the Pteridosperms. This unsatisfactory position has now been resolved by Professor Lignier, who has recently described, under the name of *Mittagia,* a fossil from the Lower Westphalian, which bore sori of which the sporangia contained four megaspores, while the outer tissues of the sporangia resembled those of *Lagenostoma.* Pending the discovery of further specimens, these observations may be welcomed as filling with all probability a conspicuous gap in the evolutionary sequence of known forms.

From the rapid survey which I have been able to give you of some of the more notable Australasian ferns of relatively archaic type, it is clear that they have a very interesting and direct bearing upon the phylesis of ferns. The basis upon which conclusions as to phyletic sequence are arrived at is at root that of the natural system of classification generally—the recognition not of one character, or of two, but of as many as possible, which shall collectively serve as criteria of comparison. In the case of the Filicales we may use the characters of:—

(i) External form.
(ii) Constitution, as shown by simple or complex segmentation.
(iii) Dermal appendages, hairs or scales.
(iv) Stellar structure, simple or complex.
(v) Leaf-trace, coherent or divided.
(vi) Soral position.
(vii) Soral construction.
(viii) Indusial protections.
(ix) Sporangial structure and mechanism of dehiscence.
(x) Spore-output.
(xi) Spore-form and character of wall.
(xii) Form of prothallus.
(xiii) Position of the sexual organs, sunken or superficial.
(xiv) Number of spermatocytes and and method of dehiscence.
(xv) Embryology.

In respect of all these criteria progressions of character may be traced as illustrated by known ferns, and probably other criteria may emerge as study progresses. In each case, upon a footing of general comparison, checked as opportunity offers by reference to the stratigraphical sequence of the fossils, it may be possible to distinguish with some degree of certainty what is relatively primitive from what is relatively advanced. Thus, the protostele is generally admitted to be more primitive than the dictyostele, the simple hair than the flattened scale, and a high spore-output than a low one.

Applying the conclusions thus arrived at in respect to the several criteria, it becomes possible upon the sum of them to lay out the species and genera of ferns themselves in series, from the primitive to the advanced. In proportion as the progressions on the basis of the several criteria run parallel, we derive increased assurance of the rectitude of the phyletic sequences thus traced, which may finally be clinched, as opportunity offers, by reference to the stratigraphical occurrence of the corresponding fossils. This is in brief the phyletic method, as it may be applied to ferns. It may with suitable variation be applied to any large group of organisms, though it is seldom that the opportunities for such observation and argument are in any sense commensurate with the requirements. Perhaps there is no group of plants in which the opportunities are at the moment so great as in the Filicales, and they are yielding highly probable results from its application.

The greatest obstacle to success is found

in the prevalence of parallel development in phyla which are believed to have been of distinct origin. This is exemplified very freely in the ferns, and the systematist has frequently been taken in by the resemblances which result from it. He has grouped the plants which show certain common characters together as members of a single genus. Sir William Hooker in doing this merged many genera of earlier writers. His avowed object was not so much to secure natural affinity in his system as readiness of identification: and consequently in the "Synopsis Filicum" there are nominal genera which are not genera in the phyletic sense at all. For instance, *Polypodium* and *Acrostichum*, as there defined, may be held from a phyletic point of view to be collective groupings of all such ferns as have attained a certain state of development of their sorus; and that they are not true genera in the sense of being associated by any kinship of descent: this is shown by the collective characters of the plants as a whole. Already at least four different phyletic sources of the Acrostichoid condition have been recognized, and probably the sources of the Polypodioid condition are no fewer. Such "genera" represent the results of a phyletic drift, which may have affected similarly a plurality of lines of descent. It will be the province of the systematist who aims at a true grouping according to descent to comb out these aggregations of species into their true relationships. This is to be done by the use of wider, and it may be quite new criteria of comparison. Advances are being made in this direction, but we are only as yet at the beginning of the construction of a true phyletic grouping of the Filicales. The more primitive lines are becoming clearer: but the difficulty will be greatest with the distal branches of the tree. For these represent essentially the modern forms, they comprise the largest number of apparently similar species, and in them parallel development has been most prevalent.

If this difficulty be found in such a group as the Filicales, in which the earlier steps are so clearly indicated by the related fossils, what are we to say for the Angiosperms? Our knowledge of their fossil progenitors is very fragmentary. But they are represented now by a multitude of forms, showing in most of their features an irritating sameness. For instance, vascular anatomy, that great resource of phyletic study in the more primitive types, has sunk in the Angiosperms to something like a dead level of uniformity. There is little variety found in the contents of embryo-sacs, in the details of fertilization, or in embryology. Even the ontogeny as shown in the seedling stages affords little consolation to the seeker after recapitulation. On the other hand, within what are clearly natural circles of affinity there is evidence of an extraordinary readiness of adaptability in form and structure. Such conditions suggest that we see on the one hand the far-reaching results of parallel development, and on the other the effects of great plasticity at the present day, or in relatively recent times. Both of these are points which prevent the ready tracing of phyletic lines. In the absence of reliable suggestions from paleontology, the natural consequence is the current state of uncertainty as to the phyletic relations of the Angiosperms.

Various attempts have been or are being made to meet the difficulty. Some, on the basis of the recent observations of Wieland and others, are attempting along more or less definite monophyletic lines to construct, rather by forcible deduction than by any scientific method of induction, an

evolutionary story of the Angiosperms. I do not anticipate that any great measure of success, beyond what is shown in a very polysyllabic terminology, and an appearance of knowing more than the facts can quite justify, will attend such efforts. It would seem to me to be more in accord with the dictates of true science to proceed in a different way, as indeed many workers have already been doing. To start not from preconceptions based upon limited paleontological data, but from an intensive study of the living plants themselves. To widen as far as possible the criteria of comparison, by making, for instance, every possible use of cellular, physiologico-chemical, and especially secretory detail, and of minor formal features, such as the dermal appendages, or by initiating a new developmental morphology of the flower from the point of view of its function as a whole; and with its physiological end clearly in sight, viz., the maturing, nourishing, and placing of new germs. To make on some such basis intraordinal, and intrageneric comparisons with a view to the phyletic seriation of closely related forms; and so to construct probable short series, which may subsequently be associated into larger phyletic groupings. This should be checked wherever possible by physiological probability. A keen eye should be kept upon such information as geographical distribution and paleontology may afford, and especially upon the fossils of the Mesozoic Period. What is above all needed for success among the Angiosperms is new criteria of comparison, to meet the far-reaching difficulties that follow from parallel development and recent adaptation. If some such methods be adopted, and strenuously pressed forward, the task should not appear hopeless, though it can not be anything else than an arduous one.

I can not conclude without some remark on the bearing of parallel or convergent development, so fully exemplified in the Filicales, upon the question of the genesis of new forms. Any one who examines, from the point of view suggested in this address, the larger and well-represented divisions of the vegetable kingdom must be impressed with the extraordinary dead level of type to which their representatives have attained. In most of these divisions the phyletic history is obscured, partly by the absence of any consecutive paleontological record, but chiefly by the want of recognized criteria for their comparison. This is very prominently the case for the mosses, and the Angiosperms.

But it may be doubted whether these large groups differ in any essential point, in respect of the genesis of their multitudinous similar forms, from the Filicales, in which the lines of descent are becoming clearer through additional knowledge. Suppose that we knew of no fossil ferns; and that none of the early fern-types included under the term "Simplices" had survived in our living flora: and that the Filicales of our study consisted only of the 2,500 living species of the old undivided genera of *Polypodium, Asplenium, Aspidium* and *Acrostichum.* Then the phyletic problem of the Filicales would appear as obscure as does that of the mosses, or of the Angiosperms of the present day. They would present, as these great groups now do, an apparent dead level of sameness in type, though the phyletic starting-points in each may have been several and distinct. There is every reason to suppose that in the phylesis of the mosses or the Angiosperms also there has been a parallel, and even a convergent, development of the same nature as that which can be cogently traced in the Filicales: but that it is obscured by the obliteration of the early stages. Internal evidence from their com-

parative study fully justifies this conclusion. How, then, are we to regard this insistent problem of parallelism and convergence from the point of view of genetic study?

A belief in the "inheritance of acquired characters," or, as it is sometimes expressed, "somatic inheritance," is at present out of fashion in some quarters. But though powerful voices may seem to have forced it for the moment into the background, I would take leave to point out that such inheritance has not been disproved. All that has been done, so far as I understand the position, is to show that the evidence hitherto advanced in support of it is insufficient for a positive demonstration. That is a very different thing from proving the negative. We hear of "fluctuating variations" as distinct from "mutations"; and it is asserted that the former are somatic, and are not inherited, while the latter are inherited. This may be held as a useful terminological distinction, in so far as it accentuates a difference in the heritable quality. But it leaves the question of the origin of these heritable "mutations" quite open. At the present moment I believe that actual knowledge on this point is very like a complete blank. Further, it leaves indefinite the relative extent and proportion of the "mutations." It is commonly held that mutations are considerble deviations from type. I am not aware that there is any sufficient ground for such a view. It may probably have originated from the fact that the largest are most readily observed and recognized as reappearing in the offspring. But this is no justification for ignoring the possibility of all grades of size or importance of heritable deviations from type.

On the other hand, adaptation, with its consequence of parallel or even convergent development in distinct stocks, is an insistent problem. The real question is, What causes are at work to produce such results? They are usually set down to the selection of favorable divergences from type out of those produced at random. But the prevalence of parallelism and convergence suggests that those inheritable variations, which are now styled "mutations," are not produced at random. The facts enforce the question whether or not they are promoted and actually determined in their direction, or their number, or their quality, in some way, by the external conditions. Parallelism and convergence in phyletic lines which are certainly distinct impress the probability that they are. Until the contrary is proved it would, in my opinion, be wiser to entertain some such view as a working hypothesis than positively to deny it. Such a working hypothesis as this is not exactly the same as a "mnemic theory," though it is closely akin to it. It may perhaps be regarded as the morphologist's presentation, while the mnemic theory is rather that of the physiologist. But the underlying idea is the same, viz., that the impress of external circumstance can not properly be ruled out in the genesis of inheritable characters, simply because up to the present date no definite case of inheritance of observable characters acquired in the individual lifetime has been demonstrated. Of course, I am aware that to many this is flat heresy. At this meeting of the association it amounts almost to high treason. I plead guilty to this heresy, which may by any sudden turn of observation be transformed into the true faith. I share it in whole or in part with many botanists, with men who have lived their lives in the atmosphere of experiment and observation found in large botanical gardens, and not least with a former president of the British Association—viz., Sir Francis Darwin.

It is noteworthy how large a number of botanists dissent from any absolute negation of the influence of the environment upon the genesis of heritable characters. Partly this may be due to a sense of the want of cogency of the argument that the insufficiency of the positive evidence hitherto adduced justifies the full negative statement. But I think it finds its real origin in the fact that in plants the generative cells are not segregated early from the somatic. In this respect they differ widely from that early segregation of germ-cells in the animal body, to which Weismann attached so much importance. The fact is that the constitution of the higher plants and of the higher animals is in this, as in many other points, radically different, and arguments from the one to the other are dangerous in the extreme. Those who interest themselves in evolutionary questions do not, I think, sufficiently realize that the utmost that can be claimed is analogy between the higher terms of the two kingdoms. Their phyletic separation certainly dates from a period prior to that of which we have any knowledge from the fossil record. Let us give full weight to this fact, as important as it is indisputable. The early definition of germ-cells in the animal body will then count for nothing in the evolutionary problem of plants. Moreover, we shall realize that the plant, with its late segregation of germ-cells, will present the better field for the inquiry whether, and how far, the environment may influence or induce divergences from type. From this point of view the widespread opinion among botanists that the environment in some sense determines the origin and nature of divergences from type in plants should command a special interest and attention.

I must now draw to a close. I have passed in review some of your more notable plants, and pointed out how the Australasian flora, whether living or fossil, includes in unusual richness those evidences upon which the fabric of evolutionary history is being based. I have indicated how this history in certain groups is showing ever more and more evidence of parallel development, and that such development, or convergence, presses upon us the inquiry into the methods of evolutionary progress. The illustrations I have brought forward in this address clearly show how important is the positive knowledge derived from the fossils in checking or confirming our decisions. Paleophytology is to be prized not as a separate science, as, with an enthusiastic view restricted between blinkers, a recent writer has endeavored to enforce. To treat it so would be to degrade it into a mere side alley of study, instead of holding it to be the most positive line that we possess in the broad avenue of botanical phylesis. An appreciation of such direct historical evidence is no new idea. Something of the same sort was felt by Shakespeare three centuries ago, and it remains the same to-day. Nay more:—it may lead us even to forecast future possibilities. In following our evolutionary quest in this spirit we shall find that we are indeed—

> Figuring the nature of the times deceased,
> The which observed, a man may prophesy
> With a near aim, of the main chance of things
> As yet not come to life.
> (King Henry IV., Part II., Act iii, Scene i.)

F. O. BOWER

THE DECREASING BIRTH RATE OF THE GERMAN EMPIRE

DURING the 30 years following the war with France the population of Germany increased enormously while the population of France remained almost stationary. But at the beginning of the new century the birth rate in Germany began to decline and is still declining at a rapid rate. In an article in No. 18 of

the *Münchener Medizinische Wochenschrift* Dr. von Gruber gives some remarkable facts about the decreasing birth rate in Germany, which are the more interesting as the same causes are underlying a decreasing birth rate in certain classes and certain regions of the United States.

Von Gruber shows that while the number of marriages in Germany remained about the same (80 per 10,000 inhabitants) the birth rate sank from 370 in 1900 to 310 in 1910. This decrease is especially marked in the cities and industrial regions. In Berlin the number of births per 10,000 inhabitants decreased from 149 in 1876 to 93 in 1912. But not only the cities, the country districts, too, show a gradual decrease in the birth rate. Especially is this noticeable in the districts adjoining large cities. In general this decrease is more marked in regions with a predominantly Protestant population, and with regard to politics, in those election districts which send regularly a socialist member to the Reichstag.

Considering the causes of this general decline of the birth rate von Gruber thinks that it is principally due to prevention of conception. He recognizes the fact, however, that this decrease is to some extent unintentional. Many of the best families die out though children are ardently desired. The causes of this phenomenon are not fully known, but alcoholism and the venereal diseases are probably the principal underlying causes.

Of special significance is the insufficient increase of the birth rate among the intellectual classes. For the safety, progress and prosperity of any nation a sufficient number of persons who are leaders of the people is necessary. Without her great statesmen and generals, her leaders in commerce and industry, in the arts and sciences, the enormous development of modern Germany would have been impossible. Both Greece and Rome perished from a steadily decreasing birth rate of the ruling race, and it is a remarkable fact that during the decline of the Roman Empire no great statesmen and generals, no great thinkers, artists and scientists, appeared. It was a period of complete stagnation. The same is true of the declining periods of Greek history.

In view of the more difficult living conditions of modern times von Gruber recognizes the right of the parents to limit the number of their children, but this limitation should not be carried so far as to endanger the safety of the state. The desire for wealth and luxury, the movement of woman's emancipation, the disappearance of a deep religious sentiment are the most destructive agencies in modern society. The destructive effects of the abandonment of old orthodox beliefs is shown by the fate of the Jewish race. Under the faithful observation of the Mosaic law the Jews maintained the strength and vigor of their race through thousands of years in the face of all opposition and persecution, but in modern times the Jews, at least so far as Germany is concerned, are threatened with extinction. They have abandoned their ancient faith, they hold the most advanced views on life, their writers are the most fanatic agitators for the overthrow of marriage and the established order of sexual relations. The chase after money, the thirst for power and pleasure, has blinded them to the fact that they are facing extinction through race suicide. These conditions are especially marked among the Jews of Berlin. From 1875 to 1910 the Jews of Berlin increased 100 per cent., but the number of Jewish births decreased during the same period 11 per cent. In 1905 the number of births per 1,000 Jewish women in the child-bearing age was only 56.8. At present their natality is only 14 per 1,000. Still less is the natality among the Jews of Bohemia and Moravia, where, according to recent statistics, it sank to 12.9 per 1,000, the lowest birth rate known among any race. This enormous decrease of births among the Jews shows that the phenomenon is not due to poverty and indigence, for the Berlin Jews are among the best situated people of that city.

A reasonable increase in population is absolutely necessary for any people to maintain its position among the nations. If the two-children system should be carried out generally,

von Gruber finds that the descendants of one million people would after 100 years only amount to 347,000 souls.

To counteract the modern tendency to race suicide von Gruber proposes (1) Improvement of the economic condition of families with many children by proper laws. (2) Limitation of the economic advantages of childlessness. (3) Suppression of those agencies which, for pecuniary gains, spread the vice of race suicide. He takes an energetic stand against those modern "reformers" who would loosen the marriage ties. He considers the modern monogamous marriage the only basis of healthy sexual relations. Freedom in marriage would become "free love" and end in general sterility. He condemns the claim of the law committee of the Federation of German Women, who maintain that "as a free person woman is the mistress over her own body and may destroy a germ which, in its initial stage, is an inseparable part of her own body." The ideal of woman's emancipation has never been more nearly approached than in Imperial Rome, where sterility was a general phenomenon.

It is nothing but just that the state bear a part of the expenses of parents with a numerous family. Parents who have three or more normal and healthy children under 14 years should be paid a monthly contribution, and if they have raised three or more children they should receive an old age pension when they have reached the age of 60 years. Besides these economic advantages von Gruber would give a father of three or more children a plural vote at all elections proportional to the number of his children. A large portion of the sums expended in the assistance of families with many children could be procured by a tax on the incomes of bachelors and parents with few or no children. Von Gruber proposes severe laws against the "propaganda for the two-children system," as well as severe penalties on criminal abortion and on the advertisement and sale of drugs and other means for the prevention of conception.

A. ALLEMANN

PATENT MEDICINES IN GREAT BRITAIN

LARGELY through the efforts of the American Medical Association and through legislation by Congress some progress has been made in the United States in limiting the dangers from the sale and use of secret medicines. The conditions are now worse in Great Britain than in this country, and in 1912 the government appointed a select committee which has just issued an abstract of its report. It finds that there is a large and increasing sale of patent and proprietary remedies and appliances and of medicated wines; that this constitutes a grave and widespread public evil and that "an intolerable state of things," requires new legislation to deal with it, rather than merely the amendment of existing laws. Legislation is recommended as follows:

1. That every medicated wine and every proprietary remedy containing more alcohol than that required for pharmacological purposes, be required to state upon the label the proportion of alcohol contained in it.

2. That the advertisement and sale (except the sale by a doctor's order) of medicines purporting to cure the following diseases be prohibited: Cancer, consumption, lupus, deafness, diabetes, paralysis, fits, epilepsy, locomotor ataxy, Bright's disease, rupture (without operation or appliance).

3. That all advertisements of remedies for diseases arising from sexual intercourse or referring to sexual weakness be prohibited.

4. That all advertisements likely to suggest that a medicine is an abortifacient be prohibited.

5. That it be a breach of the law to change the composition of a remedy without informing the Department of the proposed change.

6. That fancy names for recognized drugs be subject to regulation.

7. That the period of validity of a name used as a trade mark for a drug be limited, as in the case of patents and copyrights.

8. That it be a breach of the law to give a false trade description of any remedy, and that the following be a definition of a false trade description: "A statement, design, or device regarding any article or preparation, or the drugs or ingredients or substances contained therein, or the curative or therapeutic effect thereof, which is false or misleading in any particular." And that the onus of proof that he had reasonable ground for belief in the truth of any statement by him regard-

ing a remedy, be placed upon the manufacturer or proprietor of such remedy.

9. That it be a breach of the law: (*a*) To enclose with one remedy printed matter recommending another remedy. (*b*) To invite sufferers from any ailment to correspond with the vendor of a remedy. (*c*) To make use of the name of a fictitious person in connection with a remedy. (But it should be within the power of the department to permit the exemption of an old-established remedy from this provision.) (*d*) To make use of fictitious testimonials. (*e*) To publish a recommendation of a secret remedy by a medical practitioner unless his or her full name, qualifications and address be given. (*f*) To promise to return money paid if a cure is not effected.

THE TWENTY-FIFTH ANNIVERSARY OF THE MISSOURI BOTANICAL GARDEN

THE Missouri Botanical Garden has made arrangements to celebrate its twenty-fifth anniversary on October 15 and 16. The war in Europe may interfere with the attendance of some of the foreign delegates, but it is known that all of those on the program will make every effort to come and, in case this is impossible, their papers will be sent in time to be read. The program is as follows:

Thursday, October 15

10:30 A.M. Automobile ride through the city for delegates and visiting scientists.

1:00 P.M. Lunch at the garden.

2:00 P.M. Graduate lecture room:

Address of welcome: Director George T. Moore.

The History and Functions of Botanical Gardens: Assistant Director Arthur W. Hill, Royal Botanic Gardens, Kew, England.

The Phylogenetic Taxonomy of the Flowering Plants: Professor Charles E. Bessey, University of Nebraska, Lincoln, Nebraska.

Development of the Norwegian Flora Since the Ice Age: Professor N. Wille, University of Christiania, Christiania, Norway.

The Vegetation of Mona Island: Director in Chief, N. L. Britton, New York Botanical Garden, Bronx Park, N. Y.

The Scientific Significance of the Imperial Botanic Garden of Peter the Great, with Special Reference to the Flora of Asia: Dr. Wladimir I. Lipsky, Jardin Impérial Botanique de Pierre le Grand, St. Petersburg, Russia.

Comparative Carpology of Cruciferæ with Vesicular Fruits—Some General Biological and Systematic Conclusions: Director J. Briquet, Conservatoire et du Jardin Botaniques de la Ville Genève, Geneva, Switzerland.

The Origin of Monocotyledony: Professor John M. Coulter, University of Chicago, Chicago, Illinois.

8:30–11:30 P.M. Reception. Director's Residence.

Friday, October 16

10:30 A.M. Special personally conducted trip through the conservatories and grounds of the garden. Opportunity will be given during the morning for those who wish to spend time in the library or herbarium.

12:30 P.M. Lunch at the Garden.

1:30 P.M. Graduate lecture room:

Recent Investigations on the Protoplasm of Plant Cells and Its Colloidal Properties: Professor Frederick Czapek, Physiologisches Institut der K. K. Deutschen Universität, Prag, Austria.

Experimental Modification of the Germ Plasm: Director D. T. Macdougal, Department of Botanical Research, Carnegie Institution of Washington, Tucson, Arizona.

Hormone im Pflanzenreich: Director Hans Fitting, Botanisches Anstalten der Universität Bonn, Bonn, Germany.

The Law of Temperature Connected with the Distribution of Marine Algæ: Professor William A. Setchell, University of California, Berkeley, California.

Ueber Formbildung und Rhythmik der Pflanzen: Director George Klebs, Botanisches Institut Universität Heidelberg, Heidelberg, Germany.

Phylogeny and Relationships in the Ascomycetes: Professor George F. Atkinson, Cornell University, Ithaca, New York.

The Organization of a Mushroom: Professor A. H. Reginald Buller, University of Manitoba, Winnipeg, Canada.

A Conspectus of Bacterial Diseases in Plants: Dr. Erwin F. Smith, Bureau of Plant

Industry, U. S. Department of Agriculture, Washington, D. C.

7:30 P.M. Trustees' Banquet. Liederkranz Club.

SCIENTIFIC NOTES AND NEWS

THE British government has appointed a committee to consider questions in relation to the supply of drugs as affected by the war. The members of the committee are: Dr. J. Smith Whitaker, Sir Thomas Barlow, Sir Lauder Brunton, Dr. A. Cox, Professor A. R. Cushny, Dr. E. Rowland Fothergill, Dr. B. A. Richmond, Dr. F. J. Smith, Dr. W. Hale White, with Dr. E. W. Adams as secretary.

DR. WILLIAM H. WELCH, of the Johns Hopkins University, president of the National Academy of Sciences, is among the large number of American men of science detained on the continent by the war.

DR. EWALD HERING, professor of physiology at Leipzig, celebrated on August fifth his eightieth birthday.

THE Paris Academy of Sciences has awarded a prize of $600 to Dr. H. Vincent, for his work on typhoid fever.

DR. JOSEF MELAN, professor of bridge building at Prague, has been given an honorary doctorate of engineering by the Technical School at Brunn.

DR. FRANZ FISCHER has been appointed head of the newly established institute for fuel investigation at Mülheim.

DR. S. W. PATTERSON has been engaged by the government of Madras to undertake an investigation into the causation, prevention and possible cure of diabetes. The sum of 50,000 rupees has been given by the Raja of Pithapuram for the purpose.

DR. G. ANGENHEISTER has been appointed director of the Geophysical Observatory at Apia, Samoa.

DR. VIRGIL H. MOON, of the Memorial Institute for Infectious Diseases, Chicago, has been appointed head of the pathological department.

THE convocation orator at the University of Chicago on August 28 was Dr. Roscoe Pound, professor of jurisprudence in Harvard University and formerly professor of law in the University of Chicago. The subject of his address was "Legalism." Dr. Pound was for eleven years director of the Botanical Survey of the state of Nebraska. He is a fellow of the American Association for the Advancement of Science and a member of the Botanical Society of America.

LIEUTENANT SEDOFF, who two years ago headed an Arctic expedition to Franz Josef Land, fell ill and died, it is said, in an effort to reach the North Pole. Survivors of the expedition have arrived at Archangel.

DR. ALFRED HEGAR, formerly professor of medicine at Freiberg, has died at the age of eighty-five years.

SIR ANTHONY HOME, late surgeon-general in the British army, died on August 9, aged eighty-seven years.

PLANS have been made for the founding of an Australian Institute of Engineers.

NEXT year's conference of the British Pharmaceutical Society is to be held at Scarborough under the presidency of Mr. Saville Peck.

THE International Seismological Congress, which was to have been held at St. Petersburg, has been postponed, as has also the Meteorological Conference, which was to have taken place in Edinburgh in September.

DR. KARL BENSINGER, of Mannheim, has given 30,000 marks to the University of Freiburg for the investigation of wireless telegraphy.

THE Prussian Academy of Sciences has offered a prize of 5,000 marks for the best study of "Experience as a Factor in Perception." The articles may be in German, Latin, French, English or Italian and must reach the academy by December 31, 1916.

A SPECIAL despatch from Philadelphia furnished by the American Osteopathic Association, begins with the remarkable statement: "Announcement was made here to-day at the International Osteopathic convention that

osteopathy has been discovered to be a cure for all acute infectious diseases."

IT is stated in *Nature* that at least two English expeditions to observe the total solar eclipse of August 2, reached their destinations and observed the eclipse under most favorable weather conditions. The two parties were the observers from the Royal Observatory, Greenwich, consisting of Messrs. Jones and Davidson, and the expedition sent out by the joint permanent eclipse committee of the Royal and Royal Astronomical Societies, composed of Fathers Cortie and O'Connor and Messrs. Atkinson and Gibbs. The Greenwich party, stationed at Minsk (Russia), observed the eclipse under good conditions in a clear sky, and photographs of both the corona and chromosphere were secured. It is stated that the form of the corona was of the intermediate type, *i. e.*, of the square type, there being no larger equatorial streamers or streamers in the regions of the solar poles. The corona is also stated to have been very bright. The party under Father Cortie, S.J., took up their position at Hernoesand in Sweden, and his telegram to the Royal Astronomical Society says, "Weather perfect. All operations successful. Intermediate corona."

THERE will be examinations on October 19 for admission to the grade of assistant surgeon in the United States Public Health Service. Candidates must be between 23 and 32 years of age, graduates of a reputable medical college, and of good moral standing. The examinations are: 1, physical; 2, oral; 3, written; 4 clinical. Successful candidates will be numbered according to their attainments on examination, and commissioned in the same order. Assistant surgeons receive $2,000; passed assistant surgeons, $2,400; surgeons, $3,000; senior surgeons, $3,500, and assistant surgeon generals, $4,000 a year. For invitation to appear before the board of examiners, application should be made to the "Surgeon General, Public Service, Washington, D. C."

A BRIEF report by Edgar T. Wherry describing a deposit of carnotite near Mauch Chunk, Pa., is published as Bulletin 580-H of the United States Geological Survey. Carnotite is one of the radium-bearing metals and this deposit is believed to have been formed by precipitation from the ground water and can now be seen in process of formation where water trickles out through cracks in the rocks. The deposit is of interest, but the present knowledge regarding it is insufficient to warrant any statement as to its workability. So far as is now known the total area covered by the carnotite-bearing lenses is very small, the observed outcrops being confined to a strip but a few hundred feet in extent.

THE Berlin correspondent of the *Journal* of the American Medical Association reports that more than a year ago, under German initiative, an international health office was established in Jerusalem under the direction of Mühlens, the scientific assistant in the Hamburg Institute for Marine and Tropical Diseases. According to a recently published article of Nocht, director of the Institute for Marine and Tropical Diseases, the support of the institute at Jerusalem at present is shared in common by the German Committee for the Campaign against Malaria in Jerusalem; by Nathan Strauss of New York, and by the Society of Jewish Physicians and Scientists for Sanitary Interests in Palestine. The German committee supports the general department for combating malaria, and its chairman is at the same time the director of the institute. Nathan Strauss supports the hygienic and bacteriologic department of which the heads are Drs. Brünn and Goldberg. The Society of Jewish Physicians and Scientists has taken over the department for protection against rabies, originated by a German committee, the director of which is Dr. Behan. An accessory department for the prevention of eye diseases (director, Dr. Feigenbaum) has been added.

THE British War Office has issued to officers of the royal army medical corps the following memorandum on antityphoid inoculations:

1. There is no need to remind officers of the Royal Army Medical Corps of the disastrous effects of typhoid in recent campaigns.

2. It can hardly be hoped that improved

sanitary precautions will succeed completely in safeguarding the force from infection, since it will certainly be exposed to three sources of infection, difficult or impossible to control, namely: (*a*) Men in the incubation stage of typhoid who have accompanied or joined the force. (*b*) Unsuspected typhoid carriers. (*c*) Contact with the inhabitants of the country in which typhoid may be present.

3. The preventive value of antityphoid inoculation is now universally recognized, and is well known to all who have served in India.

4. As it was not found possible to inoculate the force on mobilization, only a small percentage of the men will have been protected, but it should be practicable, by seizing every opportunity, to raise the number of inoculated very considerably. If a unit is likely to be stationary for a short time, advantage might be taken of this with the consent of the general staff, to inoculate a certain number of men,—for example, a company or half a company, and in this way a whole regiment or other unit might be protected, without any serious interference with its duties. In the same way individual men temporarily disabled by minor ailments, or otherwise available, might be inoculated. It is strongly urged that medical officers lose no opportunity of introducing and carrying through some such system.

5. Antityphoid vaccine has been sent to the base depot of medical stores, and will be issued, as required, on requisition.

The value of the output of recoverable gold, silver, copper, lead and zinc from mines in California in 1913, according to Charles G. Yale, of the United States Geological Survey, was $26,812,489, an increase of $428,543 over the 1912 production. All the metals except zinc showed an increased yield, although the ore treated was less in quantity and there were fewer mines reporting a production than in 1912. The total recoverable value of gold from California in 1913 was $20,406,958, of which the deep mines produced $11,570,781, or 56.7 per cent. The total increase in the gold production was $693,480, of which $502,966 was in the yield from deep mines. The gold production was larger than in any other year except one since 1864. This great output was due entirely to the operations of the dredging companies and the larger deep mines, as the number of mines operated in 1913 was 245 less than in 1912. Of the gold recovered from placer mines the gold dredges reported $8,090,294, which was nearly 92 per cent. of the placer gold mined and nearly 40 per cent. of the total state yield in 1913. Since the commencement of gold dredging in California, 15 years ago, the gold recovered from this source has amounted to $63,505,485. Most of this large yield has been derived from ground which could not have been mined profitably under any of the old methods of gravel mining. The 410 deep mines sold or treated 2,495,958 tons of ore, a decrease of 145,539 tons, compared with 1912. Most of the siliceous ore, which amounted to 2,031,429 tons, was treated at gold and silver mills, yielding an average recovery of $5.61 a ton in gold and silver. The 448,439 tons of copper had a recoverable value of $1.84 a ton in gold and silver and $11.74 in copper. The 14,267 tons of lead ore treated had a recoverable value of $11.24 in gold and silver and of $23.11 for all metals. The zinc ore shipped in 1913 amounted to 1,823 tons, which was considerably less than in 1912. The recoverable silver in 1913 amounted to 1,378,399 fine ounces, valued at $832,553, an increase of 78,263 fine ounces in quantity and of $32,969 in value. The copper ores from Shasta county contained about 60 per cent. of the 1913 production of silver from California.

UNIVERSITY AND EDUCATIONAL NEWS

Dr. William J. Young has given $25,000 to the Medical Department of the University of Georgia for the improvement of its library.

The Company of Drapers of the City of London has made a grant of £500 a year for three years in aid of the work of the Department of Applied Statistics at University College, London, including the Galton Laboratory of Eugenics and the Drapers' Biometric Laboratory.

Dr. Frederick A. Saunders has resigned the professorship of physics in Syracuse Univer-

sity to accept the corresponding position in Vassar College.

DR. LAWRENCE E. GRIFFIN has been appointed professor of zoology in the University of Pittsburgh.

DR. ROBERT M. OGDEN, of the University of Tennessee, secretary of the American Psychological Association, has accepted the chair of psychology at the University of Kansas.

DR. FRIEND E. CLARK has resigned his position as professor of chemistry in Center College, Danville, Ky., to become professor of chemistry in West Virginia University.

SAMUEL W. GEISER, B.S. (Upper Iowa, '12), has been appointed professor of biology at Guilford College, North Carolina.

DEAN A. WORCESTER, B.A. (Colorado, '11), has been appointed associate professor of psychology in the University of New Mexico.

DR. HAROLD CHAPMAN BROWN, of Columbia University, has been appointed assistant professor of philosophy in Stanford University.

IRENE HUNT DAVIS, instructor in chemistry at the University of Washington, has been promoted to be assistant professor of chemistry.

THE following have been recently appointed to positions in George Peabody College for Teachers: Mr. Charles C. Colby, from the Minnesota State Normal School, as associate professor of geography; Miss Ada M. Field from Teachers College; Miss Blanche Evelyn Hyde from Newton, Mass., as assistant professors of home economics; Dr. William F. Russell, honorary fellow in Teachers College, as associate professor of secondary education. Dr. Leonidas C. Glenn, professor of geology, and Dr. John J. Luck, assistant professor of mathematics, of Vanderbilt University, have been secured to give special courses at the college.

DR. THEODORE SHENNAN, at present pathologist to the Royal Infirmary of Edinburgh, has been appointed regius professor of pathology (Sir Erasmus Wilson Chair) in the University of Aberdeen, in the place of the late Professor George Dean.

DISCUSSION AND CORRESPONDENCE

DO AZOTOBACTER NITRIFY?

UNDER the caption of "Fixation of Atmospheric Nitrogen" Mr. Dan. H. Jones, in the *Transactions* of the Royal Society of Canada, Third Series, 1913, Vol. III., Sect. IV.,[1] gives the results of certain experiments tending to show that the azotobacter form nitrates in their body tissues. He states:

> Cultures of each variety in Ashby's solution when one month old gave the nitrate reaction with phenolsulphonic acid colorimetric test. As the cultures get older, up to several months, the reaction to the test gets slightly stronger. This nitrate is retained almost altogether in the bodies of the organisms. Cultures filtered through Berkefeld filter gave only a trace of nitrate in the filtrate and a strong reaction in the mass of organisms which did not pass through the filter. The filtrate plated out showed that some of the organisms had passed through the filter. But as it took about ten days to filter enough for a test it is possible that the organisms had grown through the filter in that time. Probably the presence of a small number of organisms in the filtrate was responsible for the trace of nitrate in the tests. Mass growths on Ashby's agar, when mature, gave a strong nitrate reaction.

The author does not state to what extent pigmentation had taken place, but as the material experimented with represented old cultures it is probable that a considerable degree of pigmentation was present. He says:

> As the cultures get older, up to several months, the reaction to the test gets slightly stronger.

The present writer was deeply interested in this subject in connection with work which he was doing in 1910 and 1911 and stated in describing some samples of soil used in studying the subject of fixation,[2] that

> a certain sample gave, at the beginning of the experiment, an unsatisfactory growth of azotobacter but thirteen days later another culture made from the same sample gave a heavy membrane in four days on which brown points developed on the eighth or ninth day.

Again on page 93 of the same bulletin it is stated:

[1] The title of the article is "A Morphological and Cultural Study of Some Ozotobacter."

[2] Bull. 178, p. 87, Colo. Expt. Sta., 1911.

> The question of whether the azotobacter both fix the atmospheric nitrogen and convert it into nitric acid, respectively nitrates, or whether this latter work is done wholly by another genus or other genera of bacteria is, perhaps, a question to be settled, but, be it settled as it may . . . we have instances of the accumulation of very large quantities of nitrates in our soils always associated with the brown color which we know to be caused by the azotobacter. I believe, and this belief is based upon tentative facts, that the azotobacter are at the same time nitrifiers, *i. e.*, that they possess a double function, which, I believe, has already been asserted, but not generally accepted.

This subject has not been referred to in later bulletins because I believe that my tentative facts were interpreted wrongly.

The tentative facts referred to were, in the first place, that with pure cultures made on sand I obtained a decided color reaction with phenolsulfonic acid which might readily be taken for the reaction due to nitric acid, in the second place, the power of pigmentation in successive cultures of azotobacter weakens and finally disappears. The loss of this power of pigmentation is not permanent, for, as Professor Sackett has since shown, the addition of a very small amount of a nitrate to the culture medium restores it.

I interpreted the former fact, the reaction with phenolsulfonic acid, as rather strong proof of the presence of nitric acid and the latter fact as supporting this view. It seemed to me that the second fact given, *i. e.*, the weakening of the power of pigmentation, pointed to an ability of the azotobacter to nitrify in a limited measure and that this function was lessened in the succeeding generations grown on mannite-agar until it finally vanished while the purely vegetative function was retained apparently unimpaired. With these facts and views in mind I wrote the sentences quoted from Bull. 178 of this station but I was very far from being satisfied with the tentative facts. At my request Professor Sackett kindly made other cultures from two of his stock cultures which had shown marked ability to form pigments. These cultures were made on a much larger scale than those previously made on sand and were allowed to incubate till the pigments were well developed. The membranes were removed from the agar and the agar washed with distilled water. The wash water was rendered alkaline by the addition of sodic carbonate and evaporated to dryness. The membrane that had been removed was added to the residue and the whole was thoroughly mixed and dried. A portion of the dried mass was tested with phenolsulfonic acid and yielded a deep brown solution which, on sufficient dilution, gave a yellow color with a tinge of brown. A most excellent imitation of those unsatisfactory solutions sometimes obtained on applying this test to samples of soils. We tried such means as were at our command to remove the brown color or tinge which does not belong to the nitric acid reaction but without success. We rejected this phenolsulfonic acid test because the results were so doubtful that we considered them valueless in this particular case.

A larger portion, in fact all that we had left of the dried membrane, was treated with ferrous chlorid and hydrochloric acid with all of the precautions demanded by this method. The volume of gas evolved was only 2.3 c.c. which was transferred to an absorption burette and a freshly boiled, concentrated ferrous chlorid solution allowed to flow into the gas. No absorption took place and no brown color was produced on the margins of the slowly inflowing stream of ferrous chlorid solution which constitutes an exceedingly delicate test for nitric acid. These results indicated that our previous caution was fully justified and that the color obtained with phenolsulfonic acid was due, not to nitrates but to the action of the reagents upon the substances in the membrane itself, most probably upon the pigments.

We may add apropos to these pigments that while they are difficultly soluble or insoluble in the menstrua usually used, pure water, alcohol, etc., the presence of various salts in aqueous solution cause them to dissolve to a greater or less extent; one, which, in some cases, is sufficient to impart a yellowish-brown color to the solution. We have often met with this in ma-

king aqueous extracts of our brown soils. The phenolsulfonic acid test for nitric acid is not applicable to such soils due to the interference of these pigment reactions. We were not satisfied with the results obtained in the experiments already given so we repeated them on a still larger scale, but with the same results which we consider as positively establishing the fact that the azotobacter do not nitrify but that the pigments which they form may give with phenolsulfonic acid, especially in very dilute solutions, a color reaction deceptively similar to that given by nitric acid and this reagent.

WM. P. HEADDEN
COLORADO EXPERIMENT STATION,
FT. COLLINS, COLO.

NORTHERN LIGHTS IN SUMMER

I live at Nett Lake, Minnesota, 140 miles northwest of Duluth and 38 miles south of Fort Frances, Ontario, Canada. On the night of July 4 there was a fine display of northern lights (aurora borealis). It was as fine a display as is seen in this section even in the coldest months. There were spires and rolls of light and a bow of light which covered the whole northern sky and towards midnight reached nearly to the zenith.

ALBERT B. REAGAN
NETT LAKE, MINN.,
July 6, 1914

SCIENTIFIC BOOKS

The Cambridge Manuals of Science and Literature. Edited by P. GILES and A. C. SEWARD. New York, G. P. Putnam's Sons.

A review of the Cambridge Manuals appeared in SCIENCE of April 18, 1913; but since that date numerous additional volumes have come to hand, dealing with the most diverse topics. I give a list, with a few comments.

The Flea. By HAROLD RUSSELL.

When, some years ago, a member of the wealthy house of Rothschild took to collecting and describing fleas, there was a tendency to regard the circumstance in a humorous light, and perhaps even to enquire whether a man, to whom so many doors of opportunity were open, could not find something better to do. To-day, the connection between fleas and the plague having been established, Rothschild finds himself the greatest living authority on a subject of the highest importance to medical men, and no well-informed person has anything but praise for his work. The oriental rat-flea, the one mainly concerned in the spread of bubonic plague, was first made known to science by Rothschild, and the development of psyllology is illustrated by the collection of about a hundred thousand specimens at Tring.

Mr. Russell has had the advice of Mr. Charles Rothschild, and we may assume that his readable little book is up-to-date. It should be in the hands of medical men and the public generally, especially in regions where fleas are abundant. We would venture to suggest that if another edition appears the exceedingly crude text-figures should be replaced by better ones; that on page 81, in particular, is really scandalous.

Bees and Wasps. By O. H. LATTER.

This also is illustrated by very rough figures, without much pretence to accuracy in detail. The point of view is strictly British, but as many genera are common to Europe and America, the descriptions are more or less applicable to our species. The excellent accounts of the habits of English bees and wasps could scarcely at present be duplicated in this country, owing to the lack of observations. The work of the Peckhams on the solitary wasps, and that of various American observers on particular species of bees and wasps, is quite as good as anything done in Europe; but we still remain largely or wholly ignorant concerning the habits of many of our genera.

The Life Story of Insects. By G. H. CARPENTER.

This book is well illustrated, and the author has not hesitated to borrow many of his figures from American sources. The treatment of the subject is broad, and although the work has only 134 pages, Professor Carpenter manages to convey a great deal of information in an interesting way. This is, I think, the best brief introduction to entomology yet published.

Natural Sources of Energy. By A. H. GIBSON.

Figure 7 is a map of the world showing "regions subject to intense solar heat and with slight annual rainfall," including under this description nearly all of the western United States, even the Rocky Mountains of Colorado to their summits, and the coast of Oregon. Figure 8 is a similar map showing "regions suited for the maintenance of vegetable and plant life" (why vegetable *and* plant?). "Luxuriant vegetation shown in black;" a moderate amount in gray, and a minimum in white. The *whole* of the western United States, except tongue extending from the north through Montana, is pure white! We commend this especially to Californians, who have been under the delusion that their country supported some vegetation. Fig. 11 shows, in black, the "principal water powers of the world," and includes, in a large black area, the Rocky Mountains of Colorado and northward. How does it happen that this intensely hot region, with very little rain, and consequently next to no vegetation, is one of the principal areas where water-power may be obtained?

Submerged Forests. By CLEMENT REID.

Based on the brilliant original researches of the author, extending over many years, this discussion of the submerged forests on the coasts of the British Islands is equally fascinating to the botanist, geologist and anthropologist. It deals almost entirely with British work and phenomena, and has little to say about the labors of the Scandinavians and others in different parts of Europe. Thus, regarded as a general presentation of the matter, it seems narrow; but we can well forgive this in our appreciation of the intimate knowledge which the author has of his field, permitting him to speak with more assurance than would have been possible had he discussed the submerged forests of all Europe. For us in America the work carries many suggestions; thus we are surprised at the number of recognizable seeds obtainable from old peat deposits, permitting us to gain a fairly accurate knowledge of the herbaceous as well as woody flora of ancient times.

The Beautiful. By VERNON LEE.

An original treatment of the subject from a psychological point of view. This is, perhaps, a place where Bergson's contention that the intellect is not able to understand life strikes one with special force; but the author has no such misgivings, and proceeds to a logical and detailed analysis.

The Evolution of New Japan. By J. H. LONGFORD.

The interpretation of Japan is so difficult for an occidental that all books of this sort fall under suspicion; but Professor Longford was British Consul at Nagasaki, is now professor of Japanese in King's College, London, and is well known as a writer of works on Japan, so he has certainly won the right to be heard. The reviewer, having no critical knowledge of the subject whatever, read the little book with great pleasure, and can at least testify that it presents an exceedingly lucid account of the whole matter as the author understands it. There is here and there some evident inconsistency. Thus on page 3 we read, without qualification, that "the first emperor was Jimmu Tenno, who founded the Empire and ascended the throne in the year 660 B.C."; but on pages 17 and 143 we learn that this Jimmu is a pure myth. On page 81, the British government of 1894 receives severe censure for "sacrificing" the interests of British residents in Japan, but on page 84 we learn that as the result of the treaty thus condemned, trade "more than doubled in its volume," and the anticipated bad results did not occur.

The Wanderings of Animals. By H. GADOW.

Pearls. By W. J. DAKIN.

The Earth. By J. H. POYNTING.

The Fertility of the Soil. By E. J. RUSSELL.

The Atmosphere. By A. J. BERRY.

The Story of a Loaf of Bread. By T. B. WOOD.

The Physical Basis of Music. By A. WOOD.

The Peoples of India. By J. D. ANDERSON.

The Modern Warship. By E. L. ATTWOOD.

Naval Warfare. By J. R. THURSFIELD.

The Icelandic Sagas. By W. A. CRAIGIE.

A Grammar of English Heraldry. By W. H. ST. JOHN HOPE.

One great merit of these books is that they frequently call attention to neglected subjects, or cut familiar subjects at unfamiliar angles. Thus they should be instrumental in releasing us from the tyranny of the conventional textbook. We ought to have a similar series in America, dealing with subjects of special interest to us, and using American examples in illustration.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

The American College: What it is and What it may Become. By CHARLES F. THWING. New York, Platt & Peck Co. 1914.

President Thwing's "The American College" is a handsome book of 294 pages. Perhaps because the author had already published sixteen volumes in the same general field, the seventeenth gives the reader the impression of being thin in some spots and padded in others. The author must have either an extraordinary memory or an excellent bibliographical card index on academic subjects. At any rate, the quotations scattered through his book, if a little too numerous, are unhackneyed and interesting. His academic experience has been great and his sympathies are keen. There is little or nothing in the book with which one would disagree, and some of the sections are particularly good, as, for example, the discussion of woman's education and the frank confession of our present ignorance as to the differences between men's minds and women's. The book, as a whole, however, suffers from a lack of definite "attack" on the part of the author. It seems addressed to nobody in particular—or rather to different people at different times, students, parents, trustees, millionaires.

Possibly these matters have been discussed in some of the other books by the president of Western Reserve University, but so far as the present volume is concerned there is no mention of what seems to the reviewer to be really the most significant thing to-day—the rapid differentiation throughout the United States of the colleges that mean business from those that do not. There seems to be insufficient emphasis, also, on the need of developing a sense of individual responsibility on the part of the student, and on that most acute problem which faces every live college, that of distributing the new wine of the present vintage of thought with as little damage as possible to the bottles provided by the previous generation.

F. P. KEPPEL

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of the September *Terrestrial Magnetism and Atmospheric Electricity* are as follows: "The Local Magnetic Constant and Its Variations," by L. A. Bauer; "Magnetic Declinations and Chart Corrections Observed on the *Carnegie* from Long Island Sound to Hammerfest, Norway, June to July, 1913," by L. A. Bauer and J. P. Ault; "The Atmospheric-Electric Observations made on the Second Cruise of the *Carnegie*," by C. W. Hewlett; "On Certain New Atmospheric-Electric Instruments and Methods," by W. F. G. Swann; Letters to Editor, Notes and Recent Publications.

SPECIAL ARTICLES

THE MEASUREMENT OF CHANGES IN THE RATE OF FECUNDITY OF THE INDIVIDUAL FOWL [1]

1. THE purpose of this preliminary note is to call attention to a method of measuring and representing graphically changes in the intensity of ovarian activity, as indicated by rate of ovulation in the domestic fowl. It has been fully established[2] that if one considers the egg production records from a group or flock of hens as a whole there are observable regular and distinct cycles in the production. Thus, we have distinguished in former publications between winter, spring and summer cycles of flock production. It has not hitherto been possible to observe precisely or to measure any such cyclical changes (either

[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 70.

[2] *Cf.* Pearl, R., and Surface, F. M., "A Biometrical Egg Production in the Domestic Fowl." II. Seasonal Distribution of Egg Production. U. S. Dept. Agr. Bur. Anim. Ind. Bulletin 110, Part II., pp. 81–170, 1911.

of long or short period) in the egg production of a single individual bird, owing to the fact that the production is in discrete units. Yet while the end products of ovarian activity are discrete units there are very strong reasons for supposing that physiologically the elaboration—or production in the broad sense—of eggs by the ovary is a continuous process. This matter has been rather fully discussed in a former paper from this laboratory.[3] Evidence of another sort for the continuity (in the mathematical sense) of ovarian activity has recently been given by Gerhartz[4] in a valuable paper on metabolism in the fowl.

2. By a simple statistical expedient it is possible to represent the changes in rate of fecundity in an individual bird as a continuous curve, of which the ordinates represent the rates of egg production on a percentage scale (0 to 100) at the time intervals plotted as abscissæ. This is done by taking, as the rate of fecundity for any given day p_n, the percentage which the actual number of eggs laid by the bird during the 21 days of which p_n is the central day, is of 21. Put as a formula, if

R_{p_n} = rate of fecundity (or ovarian activity as indicated by ovulation) on the day p_n,

1 = an egg produced,

and Σ denotes summation between the indicated limits, we have

$$R_{p_n} = \frac{100\,(\sum_{p_{n-10}}^{p_{n+10}} 1)}{21}.$$

The rates so calculated for each successive day may be plotted as a curve.

3. The reasons why 21 days are chosen as the basis of the calculation rather than some other odd number of days will be fully discussed in the complete paper. Here it need only be said that there are good biological grounds for this choice. Gerhartz[5] has shown, for example, that this number represents about the average number of oocytes to which any appreciable addition of yolk is being made at any given instant of time.

4. Applying this method to records of one, two and three year old hens many interesting and novel points regarding ovarian activity, as expressed in ovulation, may be made out. The long period secular cycles of production appear much more clearly and precisely than in flock mass statistics. The steady diminution in maximum rate of fecundity per unit of time after the first spring cycle in the bird's life is very strikingly shown in the great majority of cases.

This method of measuring fecundity opens the way to the attacking *in the individual* of a number of problems which hitherto have only been amenable to indirect, statistical treatment. Such, for example, are the questions of relation of size of egg to rate of fecundity, the relation between fertility (in the fowl readily measured by hatching quality of eggs) and fecundity. There are many other interesting biological problems relating to reproduction in birds, the analysis of which will certainly be aided by the method here discussed.

The complete paper describing the method and illustrating it fully by examples will shortly be published elsewhere.

Raymond Pearl

[3] *Cf.* Pearl and Surface, *loc. cit.*

[4] Gerhartz, H., "Ueber die zum Aufbau der Eizelle notwendige Energie (Transformationsenergie)," *Pflüger's Arch.*, Bd. 156, pp. 1–224, 1914.

[5] *Loc. cit.*

THE NORTH CAROLINA ACADEMY OF SCIENCE

The North Carolina Academy of Science met in its thirteenth annual session at Trinity College, Durham, on Friday and Saturday, May 1 and 2, 1914, with 28 members in attendance. The executive committee held a meeting in the early afternoon of Friday, and this was followed by a general meeting for the reading of papers. At night, after Dean W. I. Cranford had welcomed the academy to Trinity College, President Franklin Sherman, Jr., of the academy, read his presidential address, "The Animal Life of North Carolina with some Suggestion for a Biological Survey." Following this, Professor A. H. Patterson gave a lecture on "The Gyroscope and its Modern Applications" with demonstrations of some fine apparatus. Next Mr. Bert Cunningham gave a striking demonstration of the new nitrogen tungsten lamp, comparing its light efficiency with that of

ordinary tungsten and carbon lamps consuming the same amount of current. At the conclusion of the session the faculty of Trinity College gave a smoker complimentary to the members of the academy.

The annual business meeting was held at 9 A.M. on Saturday, May 2. Reports of the executive and other committees and of the secretary-treasurer were read. An invitation for the academy to meet at Wake Forest College in 1915 was accepted. A committee was appointed to formulate and present recommendations to the next legislature for a statute regulating the ventilation of public buildings in the state. A resolution was passed endorsing President Sherman's suggestions concerning a biological survey of the state. Four new members were elected. These with present enrollment of 64 give a total of 68 members.

The following officers were elected for the ensuing year:

President—J. J. Wolfe, Trinity College, Durham.

Vice-president—A. H. Patterson, University of North Carolina, Chapel Hill.

Secretary-Treasurer—E. W. Gudger, State Normal College, Greensboro.

Additional Members Executive Committee—W. N. Hutt, State Department of Agriculture, Raleigh; J. H. Pratt, State Geological Survey, Chapel Hill; W. A. Withers, North Carolina Agricultural Experiment Station, West Raleigh.

At 9:45 the reading of papers was resumed and continued until 12:30 when the program was finished. The total attendance was 30 out of a membership of 68. The number of papers on the program was 30, of which only two were read by title. Marked features of the meeting were the considerable number of papers read and the discussions participated in by a large number of those present. Including the presidential address, which was published in full in the May number of the *Journal of the Elisha Mitchell Scientific Society*, the following papers were presented:

Presidential address—Studies of the Animal Life of North Carolina with Suggestions for a Biological Survey: F. SHERMAN, JR.

The first questions asked when any animal or plant arouses interest have to do with its identity, distribution, seasonal activities and economic relations, hence the need of biologists supplying this information in some form available for reference. Very little accurate information on these points can be obtained from the public itself, it must be threshed out by careful work on the part of the biologists. Many cases can be cited showing that forms formerly believed to be harmless are really important, as shown by discoveries in medical entomology, hence our studies should include all forms of life. Such studies should not only include the listing of species, but also the mapping out of their distribution, and the seasons of their occurrence and activities.

In this work in North Carolina, considerable progress has been made in the study of the larger marine invertebrates, chiefly at the government Biological Laboratory at Beaufort. Land invertebrates exclusive of insects have been little studied. In the insects, considerable progress has been made in many groups, especially the order Orthoptera, parts of the order Hemiptera, dragon-flies in the Neuroptera, butterflies and larger moths in the Lepidoptera, several families in the Diptera, a large number of records in Coleoptera though only a good start, and very little in the Hymenoptera.

In the vertebrates, the fish fauna is already well presented in "Fishes of North Carolina," much data has been accumulated regarding the batrachians and reptiles, a volume on the birds is now in course of preparation, and the mammals, on the whole, are fairly well known.

What has thus far been accomplished, has been largely out of fondness for the subject, and quite incidental to other duties, the data has been gathered from publications and specimens collected by many persons both within the state and from outside, and it is hoped that the biologists in the state will attempt to complete, compile and publish these records in appropriate volumes until the fauna of the state shall be definitely placed on record. Botanists are urged to undertake the same for the flora.

Such studies would supplement and strengthen the work of morphologists, and would aid the study of such directly economic problems as the life-histories of insects, spread of weeds and fungous diseases, efficiency of birds in control of pests, etc.

Economic Geology of Chapel Hill, N. C. and Vicinity: JOHN E. SMITH.

GENERALIZED SECTION OF MANTLE ROCK

	Thickness, Ft.
1. Soil, "top soil," red to gray or black...	1 to 3
2. Subsoil, fine, somewhat compact, red to yellow clay	3 to 10

3. Clay, coarse and lumpy, with some sand. 5 to 20
4. "Natural sand-clay," feldspar, quartz, sand and clay .....10 to 20
5. Fragmental rock, angular, decayed, size 2 to 4 in. .....10 to 20
6. Fragmental rock, coarser and fresher than that in 5 ..... 5 to 15
7. Granite, "bed rock," "country rock."

This region serves as a type for Piedmont areas in which granite is the underlying rock—about one third of the Piedmont Belt.

Zone No. 1 is the surface soil of the upland and is used in agriculture and in road building. No. 2 provides clay suitable for brick and tile. As the topography is mature and these zones have been removed by erosion from much of the area, the value of the land is low. The material of zone 4 makes good sand-clay roads. This is approximately horizontal and outcrops on the slopes where valleys have been cut below its depth. Stream sand is used in making mortar and in road construction.

This mantle rock forms an excellent filter and most wells in it are free from contamination. Excepting the mountain region, these are the most healthful areas in the south.

An Achlya of Hybrid Origin: W. C. COKER.

An *Achlya* was described from Chapel Hill, N. C., with peculiarities that suggest a hybrid origin. The tips of the hyphae often die and the growth is then extended as a side branch below the dead tip. The spores show a strong tendency to poor organization, the protoplasm often segregating only imperfectly, and producing irregular masses of various sizes. The same is true of the eggs, which are of any size and almost never become perfectly organized, and die quickly. The plant seems most like *Achlya polyandra* Hildeband, but differs from it in the walls of the oogonia being pitted and in the abnormal behavior of the eggs.

It is suggested that the plant may be a hybrid between *A. DeBaryana* Humphrey and *A. apiculata* DeBary.

The Nurse Sharks of Boca Grande Cay, Florida: E. W. GUDGER.

Boca Grande Cay is an island of coral sand and mangroves lying about 20 miles west of Key West. Situated on a shallow submarine platform, about 120° of its circumference is surrounded by sand flats inhabited largely by sting rays. Another 120° of its circumference is bounded by a shallow, gently sloping, rock bottom on which the water a half mile from shore will not be over a man's shoulders. On this rocky bottom, the nurse sharks, *Ginglymostoma cirratum,* come out to bask in the sun, to play, to breed, and possibly to feed. Here they are found in large numbers. A dozen can be seen at almost any time, and thirty-three have been counted in the sweep of the eye.

These sharks in looks and habits much remind one of well-fed pigs in a barnyard. They are much broader in the pectoral region than ordinary sharks, are sluggish in their movements, and are comparatively unafraid of man. They frequently lie in water so shallow that their dorsals project above the surface, and a number of times they allowed the boat to drift down over them and strike their fins before they would move.

They lie with heads on each others pectorals or tails, or one will have his snout elevated on another's flank, or they will lie heads and tails together or in a confused herd. Here again this similarity of habits to barnyard pigs is very noticeable. Further they often swim one after another to the number of three or four in an aimless fashion, each one following the purposeless turnings of its leader.

They are perfectly harmless. Their mouths are small and filled with small pointed teeth. They are omnivorous in feeding like most sharks, but their food seems chiefly to be crustacean, probably consisting of the large spiny "crawfish" common on the reef and on rocky bottom of any kind.

Under the circumstances noted above, there is, of course, no difficulty in killing these sharks. Ordinarily shark fishing is good sport, but killing nurse sharks is no more exciting than sticking pigs in a barnyard. Indeed the Key West fishermen contemptuously speak of them as "Nurses," and of the other sharks as "sharks."

Work on the habits and embryology of this shark is being carried on under the auspices of the Marine Laboratory of the Carnegie Institution of Washington situated at Tortugas and will be continued this summer.

Flowers and Seed Development of Specularia perfoliata: H. R. TOTTEN AND J. A. MCKAY.

There are two kinds of flowers, conspicuous open ones with normal corollas and small bud-like flowers that never open. The last or cleistogamic flowers were described carefully by von Mohl, as long ago as 1863.

It is the object of this paper to give the development of the seeds in the cleistogamic flowers. The seeds are of the same size and appearance as those borne in the open flowers. Four megaspores are

formed and the embryo-sac develops from the lower one. It is surrounded by a single nucellar layer and one thick integument. The endosperm nucleus forms a cellular endosperm from the first division. The young endosperm sends out a knob-like haustorium of one or two cells at each end. The suspensor of the embryo grows up into the micropylar haustorium, to some extent, forming a small enlarged knob there. As the seed grows the haustoria are encroached upon and destroyed.

Studies in the Toxicity of Cottonseed Meal: W. A. WITHERS, R. S. CURTIS AND G. A. ROBERTS.

About one hundred and seventy-five hogs were fed upon cottonseed meal or some fraction of it. The swine died in every case after eating the meal for periods ranging on average from 59 to 96 days. Twenty-two rabbits fed on cottonseed meal died on average of 13 days.

With different solvents used, the extract was usually non-toxic and the residue usually toxic.

Green feed, liberal exercise and ashes seemed to be of some aid to pigs in overcoming the toxic effect of cottonseed meal. Treatment of the meal with an alcoholic alkali rendered the meal non-toxic to rabbits.

Citrate of iron and ammonia was effective with rabbits and ferrous sulphate was effective with swine as an antidote to the toxicity of cottonseed meal.

The Locust Tree Carpenter Moth, a Formidable Parasite of the Oak: J. J. WOLFE.

In February, 1911, a white oak about fourteen inches in diameter, on the campus of Trinity College was seen to be severely injured as a result of the boring habits of what proved to be the larvæ of *Pryonoxystus robiniæ*, commonly known as the locust tree carpenter moth. The tree was cut and sections of the trunk split into two pieces. Numerous winding tunnels were found throughout the heart and sap wood of the trunk and larger limbs. From these were collected fourteen larvæ of three distinct sizes—a fact supporting the view that the insect requires three years for its development. A portion of the trunk near the ground was riddled with holes—points of exit—in which wood-destroying fungi had established themselves and threatened the destruction of the tree.

The insect attacks several trees of the street, park and forest. Its habits render it a formidable pest. Means for its control on any large scale are at present wanting, but sporadic occurrences in trees of streets and parks might possibly be held in check by injecting into these tunnels a volatile poison and then plugging them with some waxy substance.

The Pecan Twig Girdler: C. L. METCALF.

A detailed account of the egg-laying habits of *Oncideres cingulata* Say; the preliminary and supplementary maneuvers habitually performed (which result in the severing of numerous twigs from the tree in which the eggs are laid); with a brief account of the life-history, economic importance and methods of control of the pest in commercial pecan orchards.

Some Rare Plants and Singular Distributions in North Carolina: W. C. COKER.

Announcement was made of the addition of a new tree to the flora of North Carolina. The pin oak (*Quercus palustris* DuRoi) was found near Chapel Hill by Mr. J. S. Holmes, state forester, in the fall of 1913.

Rhododendron catawbiense Michx., supposed to be confined in this state to the tops of the highest mountains, was reported as growing at Chapel Hill, Hillsboro, and other places in Orange county, and stranger still at Cary (near Raleigh), and even at Selma which is well into the coastal plain.

Venus' fly trap (*Dionæa muscipula* Ellis). Evidence as to distribution of this remarkable plant was reviewed and it was concluded that this species is distributed from Buckville, S. C., to New Bern, N. C., and westward along the Cape Fear River to Fayetteville.

The tuberous variety of tall meadow oat grass (*Arrhenatherum elatius* (L.) Beauv., var. *bulbosum*) was exhibited from Chapel Hill. This is a recent introduction from Europe where it is known as a troublesome weed. Within the last three years the U. S. Department of Agriculture has received it occasionally from Virginia to Georgia.

Blessed thistle (*Cnicus benedictus* L.) was shown to be a troublesome weed in Chapel Hill grain fields.

Euonymus atropurpureus Jacq. This is found to be one of the rarest shrubs in North Carolina, and known with certainty only from Chapel Hill.

The Lawn Problem in the South: W. C. COKER AND E. O. RANDOLPH.

This paper attempts to find some way of solving the hard problem of lawn-making in the South. Observations were made on many lawns, with various conditions of soil, exposure and care, to determine the grasses and weeds actually present. About six of the most promising grasses were carefully studied to determine their value and use as lawn cover.

Exhibits were made in trays of good sods formed by these six grasses, and also of some of the worst lawn weeds.

A Rough Method of Recording Seasonal Distribution: C. S. Brimley.

The method I am about to describe is not meant to take the place of full records or complete data with regard to any group of living things in which one is particularly interested, but rather to provide a convenient means of summarizing such records and also to record data concerning animals or plants in which one is less interested and therefore is not likely to take much trouble about.

The method is briefly this: rule the left-hand pages of a blank book into 12 vertical columns, leaving enough space on the left for the names of the species to be recorded, and leaving the right-hand page blank for any additional data. At the head of these twelve columns write the abbreviations, Jan., Feb., Mar., Apl., May, Jun., Jly., Aug., Sep., Oct., Nov., Dec., and when you have a record to make of a species, record it by the appropriate letter of the month in the column for that month, J standing for early January, a for middle January, n for late January and so on, early signifying from the first to 10th inclusive, middle for from 11th to 20th, late from 21st to end of month.

I have used this method very largely for recording the seasonal range of insects and give some examples below:

	Jan.	Feb.	Mar.	Apl.	May	Jun.	Jly.	Aug.	Sep.	Oct.	Nov.	Dec.
Syrphids:												
Eristalis tenax.....		F.	Mar.	Apl.	May	Jun.	Jly.			Oct.	Nov.	Dec.
Eristalis transversa....			r.	Apl.	May	Jun.	J y.		ep.	Oct.	Nov.	Dec.
Milesia ornata.....						Jun.	ly.	Aug.	e.	Oct.	N.	
Hawk Moths:												
Protoparce sexta.....						un.	Jly.	Aug.	Sep.			
Hemaris thysbe.....			r.	Apl.	M	un.	Jly.	Au.	e.			
Ceratomia undulosa....				pl.	May	Jun.	Jly.					
Plant Bugs:												
Brochymena 4-pustulata	Jan.	Feb.	Mar.	Apl.	May	Jun.	Jly.		e.	Oct.	Nov.	Dec.
Murgantia histrionica..			Mar.	Apl.	May	Jun.	Jly.	Aug.	Sep.	Oct.	Nov	
Euschistius servus.....	Jan.			Apl.	May	Jun.	Jly.	Aug.	Sep.	Oct.		
Euschistius tristigmus..			Mar.	Apl.	May	Jun.	Jly.			Oct.	Nov.	

I have hundreds of species of insects recorded in this way and records are both easy of access and very serviceable when one wishes to find at what period of the year any particular insect is likely to occur. Of course separate records could be kept for each year and should of course be kept for different localities, but as a matter of course such a system would necessarily come into use mainly for the locality in which one spends the greater part of one's time.

E. W. Gudger,
Secretary

No abstracts have been received for the following papers:

"Movements of Plants," by J. D. Ives.

"A Report on Local Protozoa," by Z. P. Metcalf.

"By Raft and Portage: A Study in Early Transportation in North Carolina," by Collier Cobb.

"The Case of the Riparian Owner," by R. N. Wilson.

"Some Philippine Sponges," by H. V. Wilson.

"Economic Minerals in the Pegmatite Dikes of Western North Carolina," by J. H. Pratt.

"The Sclerotinia Disease of Clovers and Alfalfa," by H. R. Fulton.

"The Use of Home-made Models as an Aid in Teaching Embryology," by W. C. George.

"Electrical Conduction of Flowing Mercury," by V. L. Chrisler, presented by A. H. Patterson.

"Microscopic Demonstration of Protozoan Spores, Used as Proof of Contamination of Food with Human Excrement," by C. W. Stiles.

"Some Recent Developments in the Theory of X-rays," by C. W. Edwards.

"The Coggins Gold Mine," by J. H. Pratt.

"The Gyroscope and its Modern Applications" (with a demonstration), by A. H. Patterson.

"Geology in Relation to the Location of Highways in North Carolina," by Collier Cobb.

"The Corn Bill Bug," by Z. P. Metcalf.

"A Peculiar Case of Freezing," by R. N. Wilson.

"The Nitrogen Tungsten Lamp," by Bert Cunningham.